DO NOT ENTER: /TN/

Mail Stop AF

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

IN RE THE APPLICATION OF	)	Fedja Bobanovic
SERIAL NO.:	)	10/531,007
FILED:	)	10/13/2005
FOR:	)	Imaging Apparatus including State Machine Controller
CUSTOMER NUMBER	)	23644
CONFIRMATION NO.	)	2701
ART UNIT:	)	2872
EXAMINER:	)	Thong Q. Nguyen
ATTORNEY DOCKET NO.	)	920602-99281

RESPONSE TO FINAL OFFICE ACTION DATED NOVEMBER 30, 2009

Honorable Director of Patents and Trademarks
P.O. Box 1450
Alexandria, VA 22313-1450

Dear Sir:

In response to the Examiner's further and final Office Action of November 30, 2009, it is requested that the application be amended as follows:

In the claims

1 - 31 (cancelled)

32. (currently amended) An apparatus by which light emitted from a specimen is imaged by an image capture device to produce a video signal for creating an image in a display device or for processing and analysis, comprising:

- means for mounting the specimen,

- a light source for producing excitation light,

- a confocal scanning system adapted to direct excitation light in one direction towards, and thereby to scan an area of the specimen and also adapted to convey light emitted from the specimen as a consequence of the excitation light incident thereon, in another direction, which operates in use to scan typically repeatedly an area of interest of the specimen,

- an image capture device having discrete spatially distinct light sensitive regions on which light emitted from the specimen is focussed to form an image after being conveyed through the scanning system in said other direction, and

- control means comprising a host computer and a controller, the controller being programmed to function as a state machine <u>having a state counter, a state memory and a duration downcounter which receives a clock signal and being</u> ~~and~~ adapted to control the scanning system, and the excitation light source and/or the image capture device so that, for each image to be formed at the image capture device, light from the specimen is <u>only</u> incident on the image capture device for a specific time period equal to that required by the scanning system to scan the area of interest n times where n is a whole number equal to or greater than 1.

33. (previously presented) The apparatus as claimed in claim 32 further comprising shutter means which in use is operated by signals from the control

means to interrupt light from the excitation light source except for when the specimen is to be illuminated wherein the shutter means comprises an acousto-optic element.

34. (currently amended) The apparatus as claimed in claim 33 further comprising second shutter means between the scanning system and the image capture device, which second shutter means is operated by signals from the control means so that in use light is prevented from reaching at least part of the image capture device, except for the specific period of time during which excitation light is incident on the specimen, for the purpose of reducing errors which arise from phosphorescence, afterglow, or stray reflections ~~or light~~, reaching the image capture device.

35. (withdrawn) Apparatus as claimed in claim 32 which further includes drive means adapted to move the specimen, the scanning system, or an element of an optical system within the scanning system, along a linear axis (the Z axis) so that in use the position of the plane can adjusted relative to the specimen.

36. (withdrawn) Apparatus as claimed in claim 35 wherein in use the control system operates so as to restrict movement along the linear axis to periods during which light is prevented from reaching the image capture device.

37. (withdrawn) Apparatus as claimed in claim 35 wherein the control system is operable to only produce movement along the linear axis during periods in which the excitation source light is inhibited or prevented from reaching the specimen.

38. (withdrawn) Apparatus as claimed in claim 35 wherein the linear axis motion of the specimen, or scanning system, or element thereof, is continuous and wherein the apparatus further comprises means by which deconvolution is applied to re-sharpen the image at the image capture device, or an image produced by signals from the image capture device, which is otherwise blurred due to the said continuous motion.

39. (withdrawn) Apparatus as claimed in claim 32 wherein in use the wavelength of the excitation light is required to vary from one exposure to another, and the apparatus comprises two or more excitation light sources each producing excitation

light of a different wavelength from the or each other source, and the control means is adapted in use to select the source to provide light of appropriate wavelength for each exposure.

40. (withdrawn) Apparatus as claimed in claim 32 wherein in use the wavelength of the excitation light is required to vary from one exposure to another, the apparatus comprises a single source of excitation light which is adjustable to produce light of different wavelengths, and the control means is adapted to adjust the source to produce light having the required wavelength for each exposure.

41. (withdrawn) Apparatus as claimed in claim 32 wherein the excitation light source is operable to produce light of more than one wavelength at the same time.

42. (withdrawn) Apparatus as claimed in claim 32 wherein a single excitation light source is employed, the wavelength or wavelengths of the light emitted therefrom can be altered, and the control means is adapted to adjust the source to produce light of a desired wavelength or wavelengths wherein the light source is a laser light source which comprises an acousto-optical tuneable filter (AOTF) crystal, and the control means is adapted to provide signals to alter the frequency controlling signal to the crystal, to control the wavelength (or wavelengths) of the emitted light.

43. (withdrawn) Apparatus as claimed in claim 32 wherein the excitation light source is operable so as to produce pulses of light.

44. (withdrawn) Apparatus as claimed in claim 32 wherein the excitation light intensity is controlled by means of an attenuating element and the control means is adapted in use to control or position the attenuating element as appropriate.

45. (withdrawn) Apparatus as claimed in claim 44 wherein the attenuating element is an AOTF or LCD shutter.

46. (withdrawn) Apparatus as claimed in claim 32 wherein the control means is adapted to alter the intensity of the illumination so as to provide a predetermined intensity of illumination at the specimen for each wavelength, to remove variation in

intensity from one wavelength to another as can occur due to inherent intensity variation as between one source and another or between different modes of operation of the excitation light source.

47. (withdrawn) Apparatus as claimed in claim 32 wherein the control means is adapted to adjust the power to the excitation light source and/or control attenuation of light therefrom, from one exposure to another, to provide substantially constant intensity luminescence, to reduce variation in the intensity of the light incident on the image capture device sensor due to differing wavelengths of excitation light, or to render the light emitted due to luminescence of similar intensity irrespective of wavelength, or both.

48. (currently amended) A method of imaging light from a specimen comprising passing excitation light to the specimen via a confocal scanning system and passing light emitted by luminescence of the specimen in another direction via the scanning system to an image capture device having a sensor having discrete spatially distinct light sensitive regions, wherein the scanning system is operated so as to scan the whole of an area of interest of the specimen, and wherein the scanning system, and the excitation light and/or the image capture device are controlled by a controller that is programmed to function as a state machine and that has a state counter, a state memory and a duration downcounter which receives a clock signal, so that, for each image to be formed at the image capture device, light emitted from the specimen is only incident on the image capture device sensor for a specific time period equal to that required for scanning the whole of the area of interest n times where n is a whole number equal to or greater than 1.

49. (previously presented) The method as claimed in claim 48 wherein shutter means is provided which operates to prevent light reaching at least part of the image capture device sensor, except for said specific period of time during which the excitation light is incident on the specimen, for the purpose of reducing errors which can arise from light arising from phosphorescence, afterglow, or stray reflections, from reaching the image capture device sensor.

50. (withdrawn) A method as claimed in claim 48 wherein the specimen is at least in part transparent and a plurality of images are formed by scanning the specimen in a plurality of different spaced apart planes.

51. (withdrawn) A method as claimed in claim 50 wherein the different planes are produced by relative movement between the specimen and a scanning device forming part of the scanning system.

52. (withdrawn) A method as claimed in claim 50 wherein the different planes are produced by movement of at least one part of an optical system forming part of the scanning system so that light is brought to a focus in the specimen at different spaced apart points, each point therefore defining the position of a focal plane of the scanning system.

53. (withdrawn) A method as claimed in claim 51 wherein movement is restricted to periods during which excitation light is not incident on the specimen.

54. (withdrawn) A method as claimed in claim 51 wherein movement is restricted to periods during which the image capture device is rendered insensitive to light.

55. (withdrawn) A method as claimed in claim 51 wherein the movement is continuous for the purpose of speeding up the scanning of a specimen.

56. (withdrawn) A method as claimed in claim 55 wherein the continuous movement during the imaging results in blurring of the image, and the method includes the step of applying deconvolution to re-sharpen the image.

57. (withdrawn) A method as claimed in claim 48 wherein the excitation light is composed of light having two or more different wavelengths.

58. (withdrawn) A method as claimed in claim 57 wherein a single excitation light source is employed which comprises an acousto optic tuneable filter (AOTF) crystal and the wavelength of the emitted light is varied by altering the frequency controlling signal to the crystal as required.

59. (withdrawn) A method as claimed in claim 48 wherein the excitation light is pulsed.

60. (withdrawn) A method as claimed in claim 48 wherein the intensity of the incident excitation light is adjusted from one exposure to another by interposing neutral density filters, or opening or closing an iris diaphragm in the light path, adjusting the power to the light source, or employing an attenuating element such as an AOTF or LCD shutter, or any combination thereof.

61. (withdrawn) A method as claimed in claim 48 wherein the specimen is illuminated by light at different wavelengths and the intensity is adjusted to produce a predetermined level of excitation intensity at the specimen for each wavelength.

62. (withdrawn) A method as claimed in claim 61 wherein the adjustment produces a substantially similar level of intensity at the specimen for each different wavelength.

Remarks

The Examiner's reconsideration of the application is requested in view of the amendments above and comments which follow.

Turning first to the rejection of claim 34 under 35 U.S.C. § 112 as set forth in numbered section 8 on page 3 of the Office Action, claim 34 had been appropriately amended to delete reference to "light" in the claim, leaving reference only to other errors which have previously been set forth. With this amendment, it is submitted that all is in order.

In section 10 on page 4 of the Office Action, the Examiner has rejected independent claims 32 and 48 under 35 U.S.C. § 102(b) as being anticipated by Endo et al. The remaining claims under examination have been rejected on the basis of obviousness under 35 U.S.C. § 103(a). Reconsideration is requested.

The applicants do not agree that claims 32 and 48 are anticipated by Endo (US 2002/0097490). Endo does not disclose control means as is required by applicants' claims. In particular, Endo does not disclose a controller programmed to function as a state machine.

The Examiner has referred to Figure 19 of Endo, and expresses the view in Section 13 of the action that the computer device disclosed in Endo satisfies our claimed feature of a "state machine". Applicants do not agree with this view.

Figure 19 of Endo is described in paragraph 0219 onwards, starting on page 12. This Figure concerns a confocal scanning microscope arrangement including a computer 86 (which can be generally equated with the host computer of our claim). Figure 19 of Endo also includes a control circuit 78 which controls rotation of disk 102 and operation of CCD 46. No detail is given of the control circuit 78. There is certainly no disclosure of control circuit 78 functioning as a state machine.

It is not the case that any computer or controller can be considered a state machine. Instead, the term "state machine" will be understood by one skilled in the art to have a more specific meaning, as applicants have previously explained.

Considering matters in slightly more detail, a state machine is a specific formalism for the generation of a clear set of output codes, based on a set of input codes which may come from a memory and/or external sources, where the decision to move from one state to the next is provided by a clock signal. The behavior is thus precisely predictable and well-controllable. Use of a computer or controller does not in itself imply that it is functioning as a state machine.

The present invention uses a state machine e.g. as illustrated in Figures 4 and 5 and as described in the last paragraph on page 26 to the end of page 32 of the specification as filed. The disclosed state machine comprises elements including a state counter 60, a state memory 62 and a duration downcounter 58 which receives a clock signal (see page 27 first paragraph).

It is critical to the present invention to use a state machine to achieve precise and accurate control of components including the image capture device, excitation light source and scanning system so that these are properly synchronized, as explained in the last paragraph on page 2 of the specification. This is necessary to coordinate and synchronize the components to provide a good quality image free of defects and artefacts. Such precise control is not achievable by use of a general purpose computer or controller. Use of a state machine having features as discussed above is essential.

In order to clarify this point, claims 32 and 48 have been amended to introduce reference to critical features of the state machine, namely a state counter, a state memory and a duration downcounter which receives a clock signal. Such amendment is based on page 27 paragraphs 1 and 2.

Such claim amendment addresses the point raised in Section 13b of the office action.

Further, Endo does not disclose an arrangement in which light from the specimen is only incident on the image capture device for a specific time period equal to that required by the scanning system to scan the area of interest n times where n is a whole number equal to or greater than 1. This limitation is present in method claim 48, and claim 32 has been amended to introduce the word "only" three lines from the end to bring the two claims into conformity.

Use of a state machine controller is critical in the present invention to obtain the necessary precisely coordinated control of the components (the image capture device, excitation light source and scanning system) to achieve this requirement, in a way that is not achievable with a conventional control system such as the control circuit 78 of Figure 19 of Endo. These two areas of difference over Endo thus interact and cooperate to enable production of high quality images in a way not hitherto possible.

An information disclosure statement is also submitted herewith to bring to the attention of the Examiner prior art cited on the corresponding British application. Four additional documents were cited in British prosecution as follows:

US 2002/0024026 A

EP 1133168 A2

US 2002/0017562 A

Review of Scientific Instruments, Vol 72, No. 11, November 2001, pages 4145 to 4152 M Bomer et al.

Copies of the cited documents are submitted, other than US patent documents.

Given the above, the Examiner's further and favorable reconsideration of the application is urged.

February 16, 2010

Respectfully submitted,

William M. Lee, Jr.
Registration No. 26935
Barnes & Thornburg LLP
P.O. Box 2786
Chicago, Illinois 60690-2786
(312) 214-4800
(312) 759-5646 – Fax